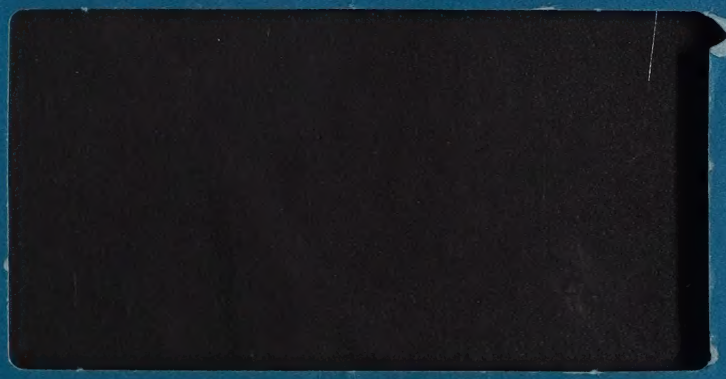
INSTRUCTION MANUAL

REGULATED POWER SUPPLIES



LAMBDA

LAMBDA ELECTRONICS MELVILLE, L. I., N. Y.

INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

LQD420 SERIES

This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to all LQD420 Series models unless otherwise specified.

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IM-LQD420

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SPECIFICATIONS AND FEATURES

Specifications apply for all metered models.

DC OUTPUT - - Voltage regulated for line and load

Voltage Range. . . . . TABLE I

VOLTAGE RANGE

MODEL	LQD-421	LQD-422	LQD-423	LQD-424	LQD-425
VOLTAGE RANGE VDC *	0-20	0-40	0-60	0-120	0-250

* With external programming, front panel potentiometer allows adjustment over a range of 1% Vo(max) to Vo(max).

Multi-Current Ranges . . . . . Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range.

TABLE II

MAX. CURRENT

MODEL	MAX. CURRENT AT AMBIENT OF:			
	30°C	40°C	50°C	60°C
LQD-421	1.7	1.5	1.3	0.9
LQD-422	1.0	.850	0.70	0.55
LQD-423	0.7A	0.6A	0.5A	0.4A
LQD-424	0.38A	0.32A	0.26	0.20
LQD-425	0.13	0.12	0.11	0.10

REGULATED VOLTAGE OUTPUT

Regulation (line) . . . . 0.005 percent plus 0.5 millivolt for input variations from 105-132 or 132-105 volts AC

Regulation (load) . . . . 0.005 percent plus 0.5 millivolt for load variations from no load to full load or full load to no load

Remote Programming

External Resistor . . . . . Nominal 1000 ohms/volt output on LQD-421 thru LQD-424. 500 Ω/volt nominal on LQD-425. Refer to page 6 for details.

Programming Voltage . . . . One-to-one voltage change

Ripple and Noise . . . . . 150 microvolts (or 300 μv for LQD-425) rms; 1.0 millivolt peak-to-peak with either positive or negative terminal grounded

Temperature Coefficient . . . . Output change in voltage less than ± (0.005% + 10 μv) /°C (with external programming resistors).

DC OUTPUT — Current regulated for line and load; automatic crossover with voltage limit

Multi-Current Ranges . . . . . Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range. For maximum current range see Table II Minimum current 1% of 30° ambient rating in Table II

Voltage Range . . . . . For voltage range see Table I, voltage ratings apply for entire current range.

REGULATED CURRENT OUTPUT; AUTOMATIC CROSSOVER

Regulation (line) . . . . . 1 milliamperes for line variations from 105-132 or 132-105 volts AC

Regulation (load) . . . . . 2.5 milliamperes (3.5 milliamperes for model LQD-425) for load voltage changes from 0 to max. or max. to 0 volts DC

AC INPUT - - 105-132 volts AC at 47-440 Hz. For input power see Table III. Ratings apply for 57-63 Hz; derate current 10% for 47-53 Hz input; for other input frequencies consult factory.

TABLE III
INPUT POWER, WATTS*

MODEL	INPUT POWER
LQD-421	190 Watts
LQD-422	190 Watts
LQD-423	190 Watts
LQD-424	190 Watts
LQD-425	125 Watts

*With output loaded to full 30°C rating and input voltage 132 volts AC, 60 Hz

OVERLOAD PROTECTION

Thermal	Thermostat, resets automatically when overtemperature condition is eliminated
Electrical	
External	Adjustable, automatic, electronic current-limiting circuit, settable to 105 percent of rated current; limits output current to preset limit for protection of load and power supply when external overloads and direct shorts occur
Internal	Fuse, "SLO-BLO", 3AG; fuse F1 protects the AC input circuit. Overload of the supply does not cause fuse failure.
	Fuse F102 or F402 provides protection against internal circuit failure in conjunction with overvoltage protector option

INPUT AND OUTPUT CONNECTIONS — Heavy duty terminal block on rear of chassis with 5-foot, 3 wire detachable line cord for all models except V and V1 option units, which have an AC receptacle in place of the 3-wire line cord and the AC input terminals on the terminal block that are used for the AC input connection on standard AC input units; five-way binding posts provide for additional positive (+) ground, and negative (-) DC output connections, on front panel of all models

OVERSHOOT — No overshoot of output voltage under conditions of power turn-on, power turn-off or power failure.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from 0°C to 60°C ambient with corresponding load current ratings for all modes of operation

STORAGE TEMPERATURE — (non-operating) -55°C to +85°C

COOLING — Convection cooled; no fans or blowers.

METERING — Digital panel meter monitors output voltage or load current as selected by METER SELECTION switch. (Separate meter for each output)

CONTROLS

DC output controls	Coarse and fine Voltage Controls on LQD-421 models, single ten-turn voltage control for LQD-422 thru LQD-425 models. (Front panel voltage control permits adjustment over a range of 1% Vo(max) to Vo(max) on all models); single turn current control for all models; located on front panel of all models.
Binding Posts (+) (-) (GND)	Five-way binding posts on front panel of all models. (One set for each output).
Remote Sensing	Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.
Power	Panel mounted switch for all units
Meter Selector	Selects digital panel meter functional. Either output voltage or current can be monitored. (One control for each DPM mounted on front panel).

PHYSICAL DATA

Size	5-3/16" H x 8-3/8" W x 10-5/8 D
Weight	12 lbs. net; 15 lbs. shipping wt.
Panel Finish	Charcoal brown (standard); special finishes available to customer specifications at moderate surcharge.

MOUNTING:

Laboratory bench, table top	Bumpers secured to the base of all LQD units permit proper circulation of air through the unit. Removal of bumpers will restrict free-flow of air through the unit; avoid removing bumpers. Retractable bench rest on bottom of unit is provided as an aid in viewing output meters.
Standard 19" Rack	All LQD units can be used with rack adapters: LRA-1 (slide accomodation provided) LRA-2 (conventional mount) See figure 14

MODEL OPTIONS

Suffix "R" Fungus Proofing Option	Standard LQD power supplies can be obtained with fungus proofing treatment with MIL-V-173 varnish for all fungi nutrient components
Suffix "V" Option	Standard LQD power supplies can be obtained for 205-265 VAC ("V1") input or for 187-242 VAC ("V") input. See nameplate for AC input rating.

ACCESSORIES

Rack Adapters	Rack adapter LRA-1, with or without chassis slides is available as well as rack adapter LRA-2 which is used for simple rack installations where chassis slides are not required
Blank Panels	Half-rack and quarter-rack panels can be used with the Lambda rack adapters, see figure 14
Overvoltage Protector	Externally mounted, Overvoltage Protectors LHOV-4, LHOV-5 and LHOV-6 are available for use with LQD power supplies LQD-421, LQD-422 and LQD-423.

OPERATING INSTRUCTIONS

CONTROLS, INSTRUMENTS AND FUSES

Power ON-OFF Switch. The power ON-OFF switch, located on the front panel, controls application of input power to both units A and B of the LQD supply. When the switch is in the ON position, the digital panel meter will be illuminated.

OUTPUT VOLTAGE Control. The OUTPUT VOLTAGE control is a dual control consisting of a coarse adjustment potentiometer, which varies the DC voltage over a range of 0.2-19 volts and a fine adjustment potentiometer, which varies the DC voltage over a one-volt range*. Clockwise rotation results in increasing voltage. The total DC voltage output for voltage regulated operation is equal to the sum of each shaft setting; for current regulated operation the maximum voltage limit is equal to the sum of each shaft setting. The control is located on the front panel of all units.

*For models LQD422 thru LQD-425 output voltage control is a single ten turn control which varies the output over a range of 1% Vo/(max) to Vo/(max).

CURRENT LIMITER Control. The CURRENT LIMITER control varies the DC current over the rated current range. Clockwise rotation results in increasing current. The control is located on the front panel of all units.

Digital Panel Meter. A digital meter monitors output voltage or current over rated range. Display illuminates when ON-OFF switch is in "ON" position. Display flashes when meter is overloaded. Meter accuracy is 5%, ± one count.

METER SELECTOR Switch. Selects meter function. Either output voltage or load current can be monitored.

Fuses. Fuse F1, internally located, is a 3 ampere, 3AG "SLO-BLO" fuse which functions in the AC input circuit.

Fuse F102 (or on B output, F402), internally located, provides protection against internal circuit failure. See schematic diagrams for current ratings of pertinent F102 or F402 fuse.

Connection Terminals. Make all connections to the supply at the terminal blocks on the rear of the supply. DC output connections can also be made at the five-way binding posts located on the front panel of all models. Apply input power through the line cord.

The supply positive terminal is brought out to terminals 6 and 14. The supply negative terminal is brought out to terminals 4 and 12. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 10. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

GROUND CONNECTIONS

The Lambda power supply can be operated either with negative or positive output terminal grounded or with no terminal grounded. Both positive and negative ground connections are shown in the diagram for all suggested output connections illustrated in this manual.

NOTE: When operating the supply with neither terminal grounded, high impedance leakage resistance and capacitance paths can exist between the power supply circuitry and chassis ground.

BASIC MODES OF OPERATION

This power supply is designed to operate as a constant voltage source or as a constant current source. Automatic crossover to either mode of operation occurs when load conditions change as follows:

Constant Voltage. The power supply will function as a constant voltage source while the load current does not equal the current value, I_{LIM}, set by the CURRENT LIMITER control. When load current $I_L = \frac{V}{R_L} = I_{LIM}$, the supply will cross over automatically and will operate as a constant current source. Further decrease in value of load resistance R_L results in decrease of voltage across the load while current remains regulated to I_{LIM}.

Constant Current (Automatic Crossover). The power supply will function as a constant current source while the load voltage V_L does not equal the voltage value set by the OUTPUT VOLTAGE control. When load voltage V_L equals the value set by the OUTPUT VOLTAGE control, the supply will automatically cross over and operate as a constant voltage source.

SUPPLY LOAD CONNECTIONS

NOTE: Refer to DETAILED OPERATING PROCEDURES for step-by-step instructions for operation of power supply.

Connections For Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Two-Wire Connection, Figure 3. The two-wire connection, with local sensing, is the connection suitable for application with relatively constant load where extremely close load regulation over full-rated current excursion is not required at the load.

Four-Wire Connection, Figure 4. The four-wire connection with remote sensing, provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be twisted pair to minimize AC pick-up. A 2.5 mf, elect, capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at 1000 ohms/volt (or on LQD-425 only, 500 ohms/volt) and a shorting-type switch as shown in figure 5. When continuous voltage variations are required, use variable resistor with the same 1000 ohms/volt (or on 425 only, 500 ohms/volt) ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation. When resistively programming downward to voltages less than 1 volt, programming must be accomplished in two steps; first, from original value to 1 volt, then from 1 volt to final desired value.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply.

Connections For Operation as a Constant Current Source

Automatic Crossover Constant Current Connections, Figure 3. Figure 3 shows the connections which are used when operating the power supply as a constant current source with automatic crossover, using local setting of current control*

*Setting control for output currents below rated limits can result in no output or no regulation.

In this mode of operation, when the load voltage increases, due to changing load resistance, to the limit of the OUTPUT VOLTAGE control setting, the power supply crossover circuit will cause the unit to operate as a constant voltage supply.

Connections For Series Operation

The voltage capability of LQD power supplies can be extended by series operation of LQD power supplies of equal* voltage ratings. A maximum of 300 volts can be connected between either the +DC or -DC terminal and chassis ground, with a maximum voltage capability of 500 volts possible for model LQD-425.

*For applications using supplies of unequal ratings, consult factory for details of operation.

This method permits operation for either constant voltage or constant current with automatic crossover to either mode of operation whenever the respective limiting operating current or voltage is reached. Figure 7 shows connection for either local or remote sensing in a series connection where the operating controls of each unit function independently to control the output, and where the B unit does not track the A unit.

Units A and B are shown connected for series operation in figures 8 and 9. Figure 8 shows the series connection diagram which would be suitable for use in all applications where tracking is desired but exact one-to-one voltage tracking of the "master" (A) unit by the "slave" (B) unit is not required. The slight offset in tracking is easily compensated for by adjusting the OUTPUT VOLTAGE controls on the (B) unit. This connection requires a minimum of 1 mA load current (2 mA on LQD425)*, R_{EXT}, calculated at 1000 ohms per volt (or on LQD-425, 500 ohms/volt), can be used for this purpose if desired.

Figure 9 shows the series connection diagram suitable for applications where exact one-to-one voltage tracking is required. In this series configuration, resistor R_{BAL} permits the (B) unit to track the (A) unit on an exact one-to-one basis, thereby eliminating the possibility of an offset voltage existing between the two units.

Resistor R_{BAL} should be a one-watt, 10-20 kilohm resistor. This value would permit wide-range compensation for manufacturing differences inherent in the components used in each unit. Resistors R_B and R_A function in the voltage sensing circuits of both units, enabling the (B) unit to reference its output voltage to that of the (A) unit. Select R_A and R_B on the basis of 1000 ohm per volt of (A) unit output voltage (or on LQD-425, 500 ohms/volt). R_A must equal R_B. This connection also requires a minimum of 1 ma. load current (2 mA on LQD425)*; R_{EXT}, calculated at 1000 ohms per volt, (or on LQD-425, 500 ohms/volt) can be used for this purpose if desired.

Capacitor C_B, used to eliminate stray AC pickup, is rated at 2.5 mfd, 200V for models LQD421, LQD422, LQD423, and is rated at 1.4 mfd, 400V for models LQD424, LQD425.

Both series connection methods permit operation for either constant voltage or constant current with automatic crossover to either mode of operation whenever the respective limiting operating current or voltage is reached. As shown in figures 8 and 9, each method permits connection for either local or remote sensing.

* For other operating conditions, consult factory for details.

Connections For Parallel Operation

The current capability of LQD power supplies can be extended by parallel operation of LQD power supplies of equal* voltage capacities. Units "A" and "B" are shown connected for parallel operation in figure 10. One power supply designated the "master" or (A) unit controls its own output as well as the output of the second power supply, designated the "slave" or (B) unit.

* For applications using supplies of unequal voltage ratings, consult factory for details of operation.

Unit (B) operates to regulate its current in a ratio to that of the (A) unit by comparing the current in its internal sampling resistor with that current sampled by the master internal sampling resistor.

Parallel connected units can be operated for constant voltage with local sensing, figure 10A, or remote sensing, figure 10B, as well as for constant current with automatic crossover, figure 10A. When operating for constant voltage, the (A) unit can automatically cross over into constant current operation.

DETAILED OPERATING PROCEDURES

The text which follows, applies to both unit A and unit B of the LPD suffix A power supply.

SAFETY NOTICE

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY

Constant Voltage Operation, Adjustable Current Limit

1. Remove AC power to the supply and place power ON-OFF switch in OFF position before connecting load to the supply.

2. Determine load requirements, select wire size from figures 1 and 2 and choose desired type of supply-load connection from figures 3 and 4.

3. Connect supply to load as shown on the selected connection diagram.

NOTE: When shipped from the factory, the supply is ready for use as a local-sensing constant voltage source with automatic cross over or as a constant current source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram.

4. Turn OUTPUT VOLTAGE control knobs to the desired voltage setting.

5. When current to the load must be limited to an intermediate value within the current rating of the supply, turn the CURRENT LIMITER controls to the desired current limit setting. If no intermediate current limit is required, turn the control CW to the position for full current rating for the maximum ambient temperature of operation. Refer to section on SPECIFICATIONS AND FEATURES.

6. Apply AC power to the supply.

7. Place power ON-OFF switch in ON position and check that Digital Panel Meter illuminates.

8. Check that digital panel meter* indicates desired values; as required, adjust OUTPUT VOLTAGE control knobs and CURRENT LIMITER controls to obtain correct meter indications. For remote sensing connections, check at the load terminations of sensing leads on terminals 3 (11) and 7 (15).

*Ammeter indicates a nominal 1 to 2 milliamperes offset from zero, which is the sensing divider current and not load current. For load current use the 1 to 2 ma. point as zero point.

9. Power supply is now in proper operation.

Programmed Constant Voltage Operation, Adjustable Current Limit

1. Remove AC power input to the supply and place power ON-OFF switch in OFF position before connecting load to the supply.

2. Determine load requirements, select wire size and length from figures 1 and 2 and choose desired type of supply-load connection from figures 5 or 6. Refer to paragraph on Programmed Voltage Connections.

3. Connect supply to load as shown on the selected connection diagram. As shown in figure 5, take care to use a shorting-type switch for the external programming control when several voltages are desired and the programming voltage method is not used. Select applicable value for capacitor C. Note that when resistively programming downward to voltages less than 1 volt, programming must be accomplished in two steps; first from original value to 1 volt, and then from 1 volt to final desired value.

4. Turn OUTPUT VOLTAGE control knobs to the extreme CCW position. Adjust external programming voltage control to desired voltage setting.

5. When current to the load must be limited to an intermediate value within the current rating of the supply, turn the CURRENT LIMITER controls to the desired current limit setting. If no intermediate current limit is desired, turn the controls CW to the position for full rated current for the ambient temperature of operation. Refer to section on SPECIFICATIONS AND FEATURES.

6. Apply AC power to the supply.

7. Place power ON-OFF switch on ON position and check that Digital Panel Meter is illuminated.

8. Check that digital panel meter* indicates desired values; as required, adjust CURRENT LIMITER controls and external programming voltage control to obtain correct meter indications. For remote sensing connections check at the load terminations of sensing leads on terminals 3 (11) and 7 (15).

*Ammeter indicates a nominal 1 to 2 milliamperes offset from zero, which is the sensing divider current and not load current. For load current use the 1 to 2 ma. point as zero point.

9. Power supply is now in proper operation.

Constant Current Operation With Crossover, Adjustable Voltage Limit

1. Remove AC power input to the supply and place power ON-OFF switch in OFF position before connecting load to the supply.

NOTE: When shipped from factory, the supply is ready for use as a constant current source with automatic crossover or as a local-sensing constant voltage source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram. When the five way binding posts are used, do not remove barrier strip jumpers.

2. Determine load requirements, select wire size and length from figures 1 and 2 and connect load to the supply as shown in figure 3.

3. Turn the CURRENT LIMITER controls to the desired current setting.

4. When load voltage must be limited to an intermediate value within the voltage rating of the supply, turn OUTPUT VOLTAGE control knobs to the desired voltage limit setting. If no intermediate voltage limit, within rating of supply is desired, turn controls to the full CW position to obtain voltage limit at maximum voltage rating of the supply.

5. Apply AC power to the supply.

6. Place power ON-OFF switch in ON position and check that Digital Panel Meter illuminates.

7. Check that digital panel meter* indicates desired values; adjust OUTPUT VOLTAGE control knobs and CURRENT LIMITER control as required to obtain correct indications.

*Ammeter indicates a nominal 1 to 2 milliamperes offset from zero, which is the sensing divider current and not load current. For load current use the 1 to 2 ma. point as zero point.

8. Power supply is now in proper operation.

*

Series Connection Constant Voltage Operation, With Current Limit

1. Remove AC power input to supply and place power ON-OFF switch in OFF position before connecting load to the supplies.

NOTE: When shipped from factory, the supply is ready for use as a constant current source with automatic crossover or as a local-sensing constant voltage source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram. When the five way binding posts are used, do not remove barrier strip jumpers.

2. Determine load requirements, select wire size from figures 1 and 2, choose correct type of series supply-load connection from figures 7-9 and connect accordingly. Refer to paragraph on Connections for Series Operation.

3. As required select R_A, R_B, R_{BAL}, R_{EXT} in accordance with instructions contained in Connections for Series Operation and connect in accordance with appropriate connection diagram.

*Applies only to units of equal voltage and current capacities, when units of unequal ratings are series connected, consult factory.

4. Set output voltage for the combination as follows:

(a) If figure 7 connection was chosen, turn OUTPUT VOLTAGE control knobs of both unit A and B to obtain the desired output voltage. These settings must add up to be the output voltage for the combination.

(b) If figure 8 connection was chosen, disconnect load from supply. Apply AC power input, and place power ON-OFF switch in ON position. Set OUTPUT VOLTAGE controls of (A) unit for maximum rated voltage, then set OUTPUT VOLTAGE controls of (B) unit for the same position. Turn A unit OUTPUT VOLTAGE controls until combined voltmeter indications total the desired output voltage for the combination. Place power ON-OFF switch in OFF position and connect load to the supply.

(c) If figure 9 connection was chosen, turn OUTPUT VOLTAGE control knobs of unit A to a setting that is approximately one-half of the desired output voltage for the combination. Turn (B) unit OUTPUT VOLTAGE control knobs and CURRENT LIMITER control knobs to extreme CW position.

5. When current to the load must be limited to an intermediate value within current rating of the units, proceed as follows:

When figure 7, 8, or 9 connection is chosen, turn CURRENT LIMITER control knobs of each unit to a setting equal to desired total current limit for the combination; offset the (B) unit control to a position slightly more than the total current limit for the combination.

If no intermediate current limit is required, turn the CURRENT LIMITER control knobs of each unit CW to the position for full current rating for the maximum ambient temperature of operation. Refer to section on SPECIFICATIONS AND FEATURES.

6. Apply AC power to the supplies.

7. Place power ON-OFF switches of both units in ON position and check that Digital Panel Meters illuminate.

8. Check that output current* and output voltage meters indicated desired values; total voltage is equal to sum of output voltage of both units. As required, adjust OUTPUT VOLTAGE control knobs and CURRENT LIMITER controls of the appropriate units to obtain correct indications.

*Ammeter indicates a nominal 1 to 2 milliamperes offset from zero, which is the sensing divider current and not load current. For load current use the 1 to 2 ma. point as zero point.

For remote sensing connection, make checks at the load terminations of sensing leads from terminal 7 of unit (A) and from terminal 11 of unit (B) when figure 7 and 8 connections are used, or from terminal 7 of unit (A) and from R_B connection at the load when figure 9 connection is used.

Series Connection Constant Current Operation, With Voltage Limit

1. Remove AC power input to supply and place power ON-OFF switch in OFF position before connecting load to the supplies.

2. Determine load requirements, select wire size from figures 1 and 2, choose correct type of series supply-load connections from figures 7A, 8A and 9A and make supply-load connections as shown on selected figure. Refer to paragraph on Connections for Series Operation.

3. As required select resistors R_{BAL}, R_A, R_B, and R_{EXT} as instructed in Connections for Series Operation paragraph.

4. If figure 7A is used, turn CURRENT LIMITER controls of each unit to the desired total current limit setting. If figure 8A or 9A is used, turn CURRENT LIMITER controls of (A) unit to total current limit setting and the CURRENT LIMITER controls of (B) unit to a position slightly higher than total current setting.

5. When load voltage must be limited to an intermediate value within the voltage rating of the series combination, turn the OUTPUT VOLTAGE control knobs to a position for total intermediate voltage required for the combination. Total voltage is the sum of the voltage settings of each unit when figure 7A is used. For figures 8A or 9A, set OUTPUT VOLTAGE control of (A) unit to approximately one-half the total voltage limit desired, and adjust VOLTAGE control of (B) unit to equal the setting indicated by the (A) unit VOLTAGE controls.

If no intermediate voltage limit is required, turn the controls to the full CW position to obtain voltage limit at the maximum combined ratings of the supplies.

6. Apply AC power to the supplies.

7. Place power ON-OFF switches of both units to ON position and check that Digital Panel Meter illuminates.

8. Check that output current* and output voltage meters indicate desired values; total voltage is the sum of (A) and (B) unit voltages. As required, adjust OUTPUT VOLTAGE control knobs and CURRENT LIMITER controls of appropriate units to obtain correct indications.

*Ammeter indicates a nominal 1 to 2 milliamperes offset from zero, which is the sensing divider current and not load current. For load current use the 1 to 2 ma. point as zero point.

9. Power supplies are now in proper operation.

Parallel Connection Constant Voltage Operation, With Current Limit

1. Remove AC power input to supply and place power ON-OFF switch in OFF position before connecting load to the supplies.

2. Determine load requirements, select wire size from figures 1 and 2 in the manual. Refer to paragraph on Connections for Parallel Operation.

3. Connect supplies to load as shown in connection diagram, figure 10A, for local sensing, or figure 10B for remote sensing.

NOTE: When shipped from the factory, each supply is ready for use as a local-sensing constant voltage source with automatic crossover or as a constant current source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the connection diagram.

4. Turn OUTPUT VOLTAGE control knobs on the (A) unit to the desired voltage setting, and turn the OUTPUT VOLTAGE controls on the (B) unit to fully CCW position.

5. When current to the load must be limited to an intermediate point, turn the CURRENT LIMITER controls on both the (A) and (B) units to the desired current limit setting. Set current limit control on the (A) and (B) units to the position indicating the current value to be delivered by the respective unit. If no intermediate current limit is desired, turn the controls CW on both (A) and (B) units to the position for full rated current for the maximum ambient temperature of operation. Refer to section on SPECIFICATIONS AND FEATURES.

6. Apply AC power to each supply.

7. Place power ON-OFF switch in ON position and check that Digital Panel Meter illuminates.

8. Check that output current* and output voltage meters on both (A) and (B) units indicate desired values; as required, adjust OUTPUT VOLTAGE controls and CURRENT LIMITER controls on (A) unit to obtain correct meter indications. For remote sensing connection check at the load termination of sensing leads on terminals 3 and 7 of the (A) unit.

*Ammeter indicates a nominal 1 to 2 milliamperes offset from zero, which is the sensing divider current and not load current. For load current use the 1 to 2 ma. point as zero point.

9. Power supplies are now in proper operation.

Parallel Connection Constant Current Operation, With Voltage Limit

1. Remove AC power input to supply and place power ON-OFF switch in OFF position before connecting load to the supplies.

2. Determine load requirements, select wire size from figures 1 and 2 and connect load to the supplies as shown in figure 10A. Refer to paragraph on Connections for Parallel Operation.

3. Turn the CURRENT LIMITER control knobs on (A) unit to the desired current setting. Turn OUTPUT VOLTAGE control knobs on the (B) unit to full CCW position.

NOTE: When setting the CURRENT LIMITER knobs on the (A) and (B) units take care to set the control so that each unit indicates the proportion of total current that the unit must supply.

4. When load voltage must be limited, turn OUTPUT VOLTAGE control knobs on the (A) unit to the desired voltage limit setting. If no voltage limit within rating of the supply is desired, turn controls on the (A) unit to the full CW position.

5. Apply AC power to supply.

6. Place power ON-OFF switch in ON position and check that Digital Panel Meter illuminates.

7. Check that output current* and output voltage meters on both units indicate desired values; adjust OUTPUT VOLTAGE controls and CURRENT LIMITER controls, as required, to obtain correct indications.

*Ammeter indicates a nominal 1 to 2 milliamperes offset from zero, which is the sensing divider current and not load current. For load current use the 1 to 2 ma. point as zero point.

8. Power supplies are now in proper operation.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown

The thermostat opens the input circuit only when the temperature of the internal chassis exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the internal chassis decreases to safe operating value. After eliminating the cause(s) for overheating and allowing time for the power supply to cool to a proper temperature, resume operation of the supply. Refer to appropriate operation paragraph in DETAILED OPERATING PROCEDURES.

Fuse Shutdown

Internal component failure is prevented by fuses which protect the components from damage caused by excessive currents. Fuses will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative. When the LQD supply is used with the overvoltage protector option, fuse F2 will provide protection against internal component failure.

MAINTENANCE

GENERAL

This section describes trouble analysis routine, replacement procedures, calibration and test procedures that are useful for servicing the Lambda power supply. Refer to the section on SPECIFICATIONS AND FEATURES for the minimum performance standards.

The text of this section refers to component designations of unit (A) of the LQD supply, but it is equally applicable for unit (B) which has identical components designated in the 400 series.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before trouble shooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumper and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 11, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an instrument that has a highly limited current capability. Observe proper polarity for PNP or NPN to avoid error in measurement. The forward transistor resistance is low but never zero; backward resistance is always higher than the forward resistance.

For good transistors, the forward resistance for any junction is <u>always</u> greater than zero.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional defective components could damage the replaced component.

When soldering semi-conductor devices, wherever possible, hold the lead being soldered with a pair of pliers placed between the component and the solder joint to provide an effective heat sink.

<u>NOTE:</u> The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact but not covered with solder it is a good contact. Do not attempt to cover with solder.

2. Voltage measurements can be made from either side of the board. Use a needlepoint probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to the measuring instrument.

3. Wherever possible use a heat sink when soldering transistors.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire sot that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:

(a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

(b) Dip the wick in liquid rosin flux.

(c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

(d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

COMPLETE POWER SUPPLY CALIBRATION PROCEDURE

When the power supply is to be completely calibrated, the controls listed below must be calibrated in the order listed.

Control Calibration Order

R102 V_0 max adjust
R104 I_0 at V_0 max adjust
R204 meter reference calibration
R213 Voltmeter calibration
R242 Ammeter calibration

ADJUSTMENT OF VOLTAGE CALIBRATION CONTROL R102

The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature or 25-30°C and is operated at nominal line voltage, no load.

ADJUSTMENT OF CALIBRATION CONTROLS

Whenever R101, R1 or IC101 are replaced, and voltage indications do not reflect maximum ratings, adjust R102 as follows:

1. Apply AC power to the supply and place power ON-OFF switch in OFF position.

2. Break seal on wiper of R102 from resistor housing.

3. Place power ON-OFF switch in ON position.

4. Turn OUTPUT VOLTAGE controls (R1) fully CW.

5. Adjust R102 until maximum output voltage is reached (as indicated by digital panel meter). If better than 2% accuracy is required, connect a DVM (John Fluke Model 825A or equivalent) at supply output terminals to measure output voltage.

6. Place power ON-OFF switch in OFF position.

7. After adjustment is completed, remove AC power input to the supply and reseal the wiper of R102 to potentiometer housing.

ADJUSTMENT OF CURRENT CALIBRATION CONTROL R104

The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C and is operated at nominal line voltage.

Whenever R2, R126, R103, R104 and IC101 are replaced, and current indications do not reflect published ratings at Vo max, adjust R104 as follows:

1. Apply AC power to the supply and palce power ON-OFF switch in OFF position.

2. Break seal on wiper of R104 from resistor housing.

3. Turn VOLTAGE ADJUST control (R1) fully CW.

4. Turn CURRENT LIMITER control (R2) fully CW.

5. Place power On-OFF switch in ON position.

6. Connect load to unit and adjust load to obtain 105% of maximum rated output current at Vo max (as indicated on external ammeter). If greater accuracy is required, connect an ammeter in series with load to measure output current.

7. Connect external voltmeter across +V and -V terminals.

8. Adjust R104 until output voltage drops (as indicated by external voltmeter).

9. Place power ON-OFF switch in OFF position.

10. After adjustment is completed, remove AC power input to the supply and reseal the wiper of R104 to potentiometer housing.

ADJUSTMENT OF METER REFERENCE CALIBRATION CONTROL, R204

The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C and is operated at nominal line voltage, with no load.

1. Apply AC power to the supply and place power ON-OFF switch in OFF position.

2. Break seal on wiper of R204 from resistor housing.

3. Connect a digital voltmeter, Data Technology Model 40 or equivalent, plus lead to terminal TP2 and minus lead to terminal TP1.

4. Place power ON-OFF switch in ON position. Adjust R204 until digital voltmeter indicates 100 millivolts.

5. Place power ON-OFF switch in OFF position.

6. After adjustment is completed, remove AC power input to the supply and reseal the wiper of R204 to the potentiometer housing.

ADJUSTMENT OF VOLTMETER CALIBRATION CONTROL, R213.

The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C and is operated at nominal line voltage, no load.

1. Apply AC power to the supply and place power ON-OFF switch in OFF position.

2. Break seal on wiper of R213 from resistor housing.

3. Connect a DVM (John Fluke Model 825A or equivalent) at rear output sensing terminals +S and -S to measure output voltage.

4. Place power ON-OFF switch in ON position.

5. Observing the DVM, adjust front panel voltage control for rated maximum output voltage.

6. Place METER SELECTION switch in VOLTS position.

7. Adjust R213 so that front panel meter reading is identical to external DVM reading.

8. Place power ON-OFF switch in OFF position.

9. After adjustment is completed, remove AC power to the supply and reseal the wiper of R213 to the potentiometer housing.

ADJUSTMENT OF AMMETER CALIBRATION CONTROL, R242

The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C and is operated at nominal line voltage.

1. Apply AC power to the supply and place power ON-OFF switch in OFF position.

2. Break seal on wiper of R242.

3. Connect an external ammeter between the +V and -V output terminals.

4. Place power ON-OFF switch in the ON position.

5. Observing the external ammeter, adjust the front panel CURRENT LIMITER control for maximum rated current.

6. Place METER SELECTION switch in AMPS position.

7. Adjust R242 so that front panel meter reading is identical to reading indicated by the external ammeter.

8. Place power ON-OFF switch in OFF position.

9. After adjustment is completed, remove AC power to the supply and reseal the wiper of R242 to the potentiometer housing.

PERFORMANCE CHECKS

Checks With Constant Voltage Operation. Check the ripple and regulation of the power supply using the test connection diagram shown in figure 12. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC DVM (John Fluke Model 871A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the load to no load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power-supply line regulation accuracy on the differential meter.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

Checks With Constant Current Operation. Check the ripple or regulation of the power supply using the test connection diagram shown in figure 13. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Check the power supply load regulation accuracy while switching from the short circuit to load condition. Measure the voltage across sensing resistor Rs. Use John Fluke Model 871A or equivalent for the DVM connected across Rs. For Rs, use a resistor having the same value as resistor R3 in the unit being tested. To obtain regulation figure substitute values obtained into regulation formula:

$$\frac{\Delta E}{Rs} = \text{Regulation in milliampers,}$$

where ΔE is the voltage change in millivolts and Rs is the resistance of the sensing resistor.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power supply line regulation accuracy using the VTVM and the regulation formula:

$$\frac{\Delta E}{Rs}$$

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.

2. Lambda part number.

3. Description of part together with circuit designation.

4. If part is not an electronic part, or is not listed, provide a description, function, and location of the part.

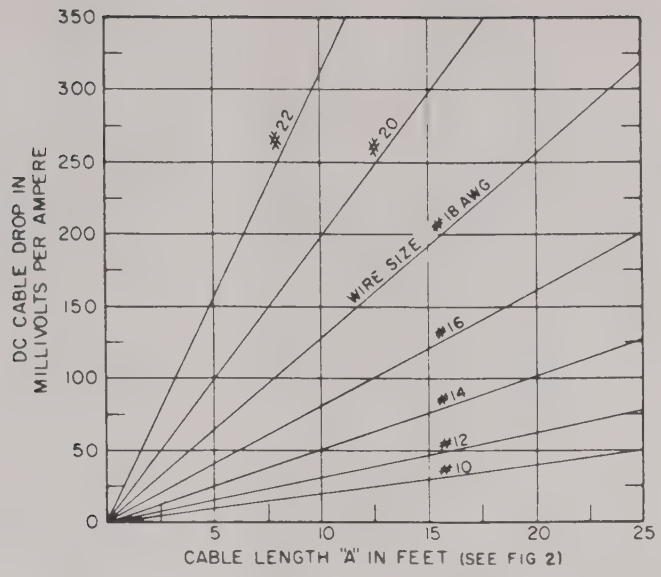


Figure 1. Cable Connection Chart

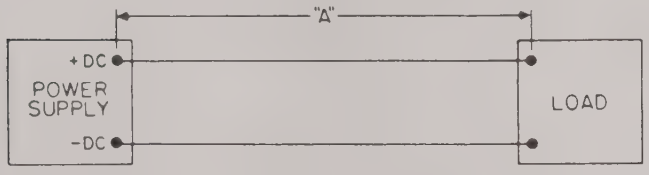
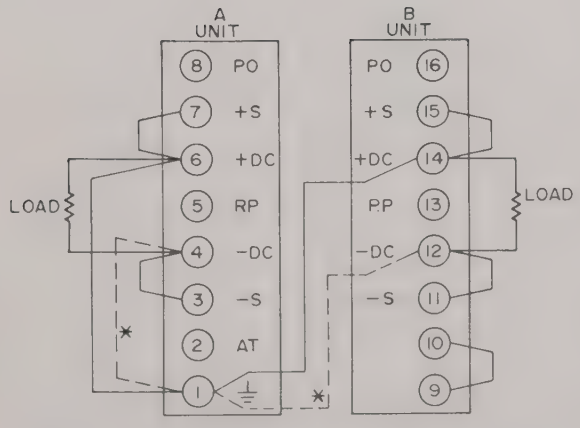
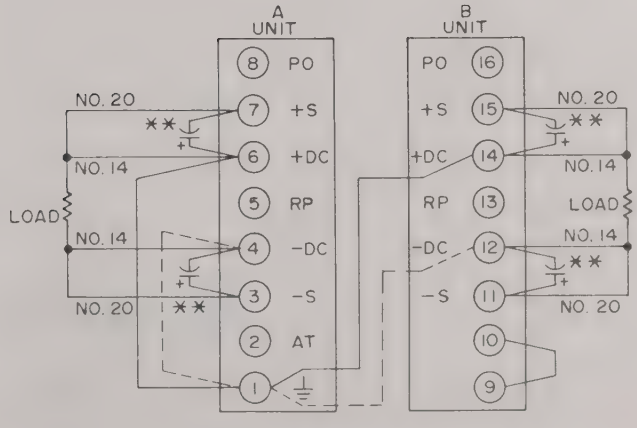


Figure 2. Cable Length "A" in Feet



* FOR NEGATIVE GROUND DISCONNECT JUMPERS FROM TERMINALS 1-6, 1-14 AND RECONNECT TO TERMINALS 1-4, 1-12.

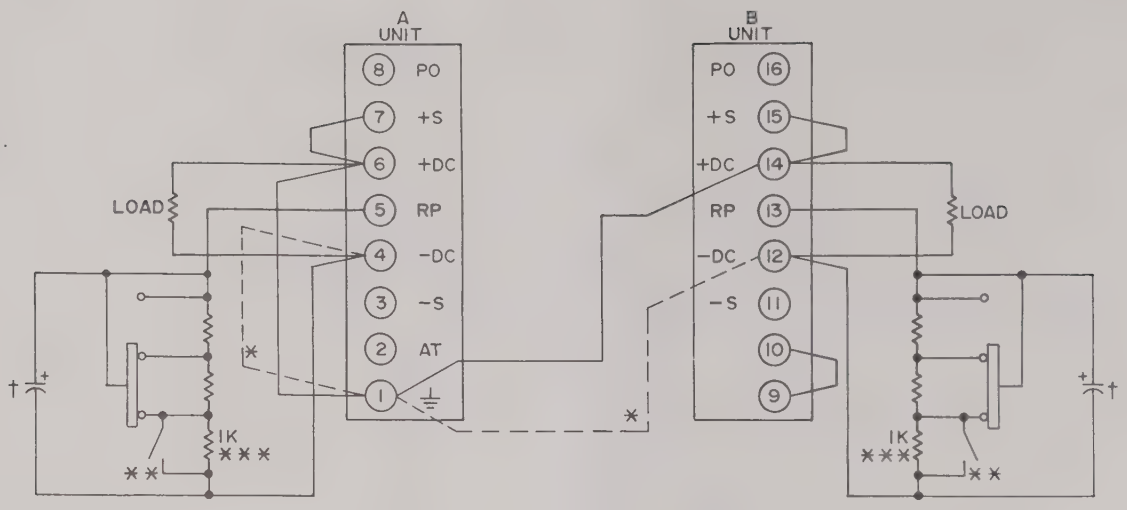
Figure 3. Two-Wire Connection



* FOR NEGATIVE GROUND DISCONNECT JUMPERS FROM TERMINALS 1-6, 1-14 AND RECONNECT TO TERMINALS 1-4, 1-12.

** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

Figure 4. Four-Wire Connection

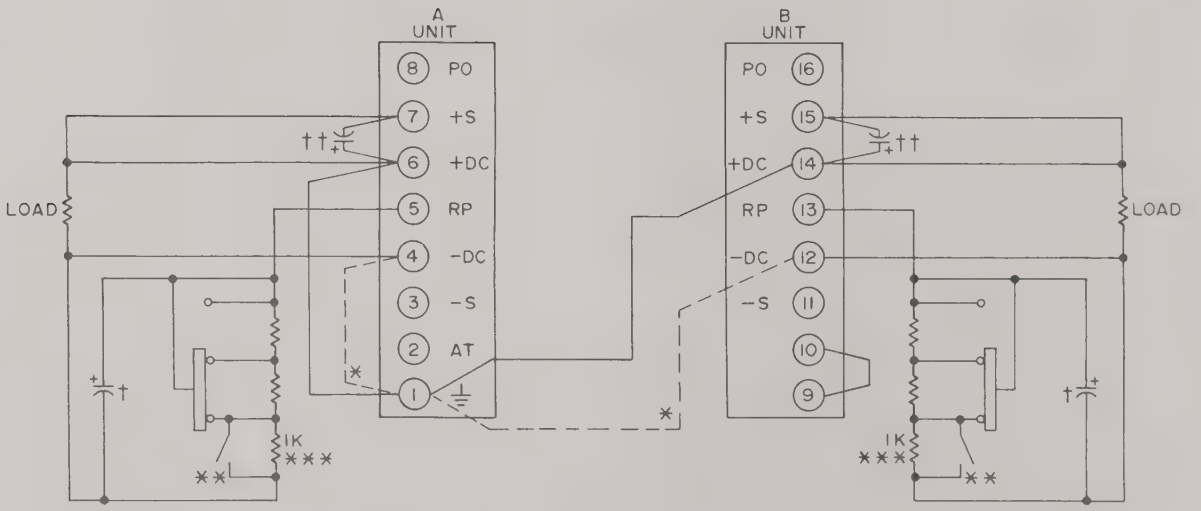


PROG. RES. = 200Ω/VOLT

** RESISTOR AND SWITCH REPRESENT A TYPICAL METHOD OF ACHIEVING THE PROGRAMMING SEQUENCE DESCRIBED ON PAGE 6.

*** 500 OHMS ON LQD-425 MODELS.

(A) LOCAL SENSING



PROG. RES. = 200Ω/VOLT

** RESISTOR AND SWITCH REPRESENT A TYPICAL METHOD OF ACHIEVING THE PROGRAMMING SEQUENCE DESCRIBED ON PAGE 6

*** 500 OHMS ON LQD-425 MODELS.

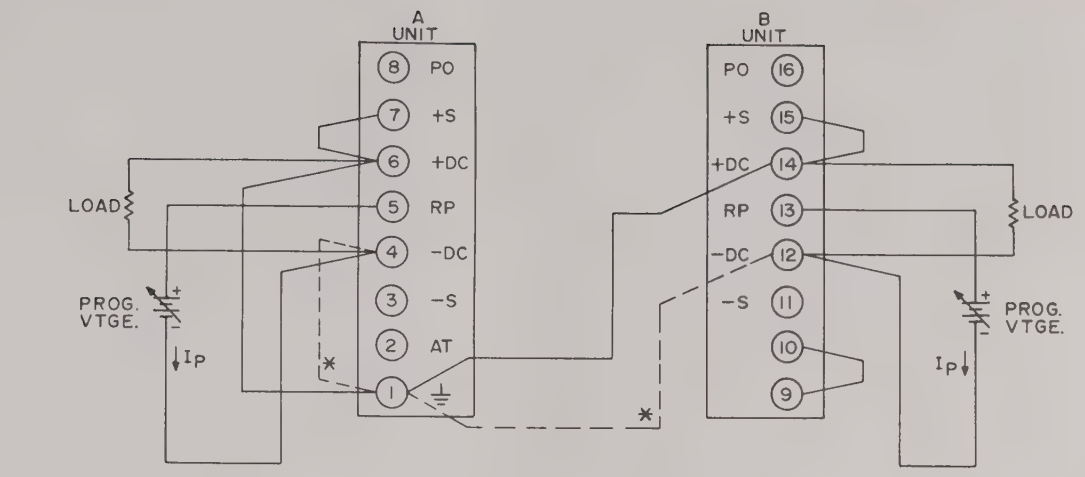
(B) REMOTE SENSING

* FOR NEGATIVE GROUND DISCONNECT JUMPERS FROM TERMINALS 1-6, 1-14 AND RECONNECT TO TERMINALS 1-4, 1-12.

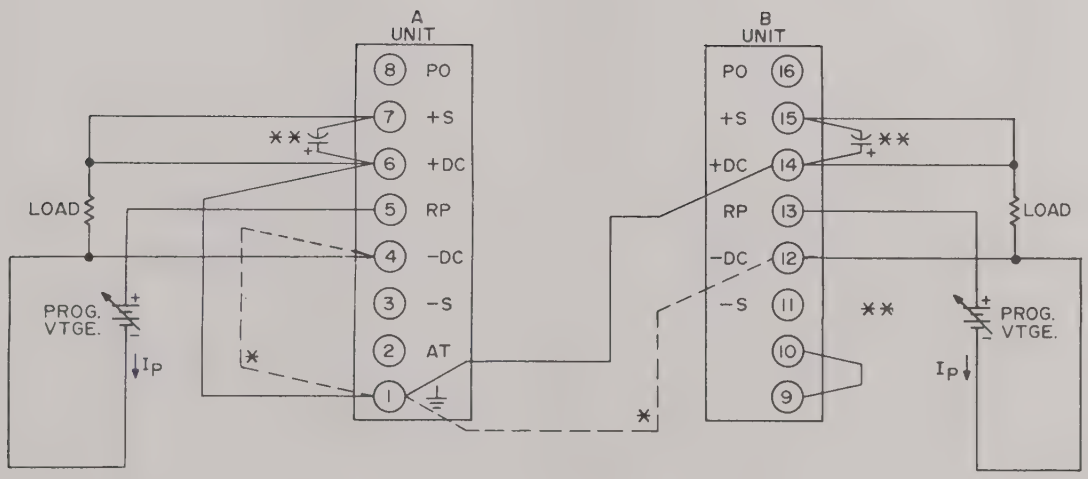
† C=2.5 MFD, 200V FOR MODELS LQD 421, 422, 423
C=1.4 MFD, 400V FOR MODELS LQD 424, 425

†† A 2.5 MFD, ELECT., CAP. MAY BE REQUIRED.

Figure 5. Programmed Voltage, With External Resistor



(A) LOCAL SENSING

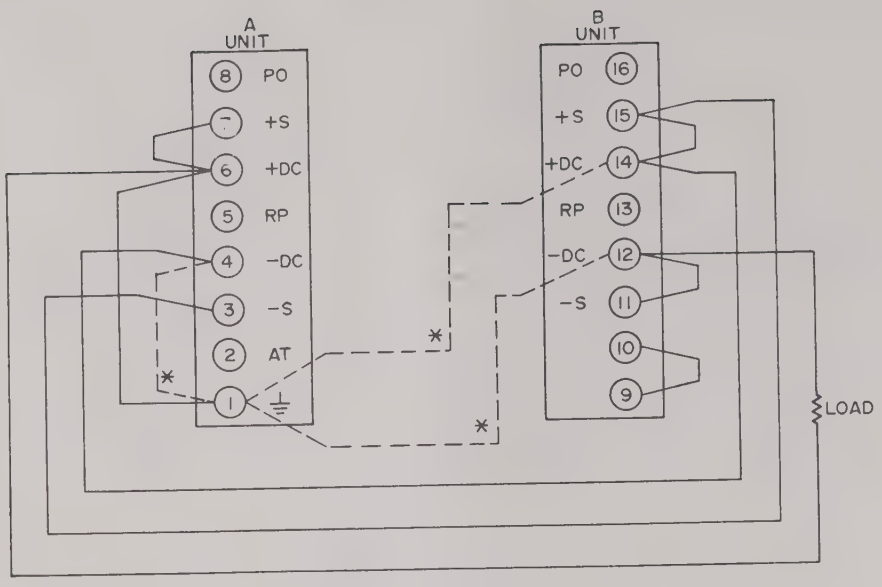


(B) REMOTE SENSING

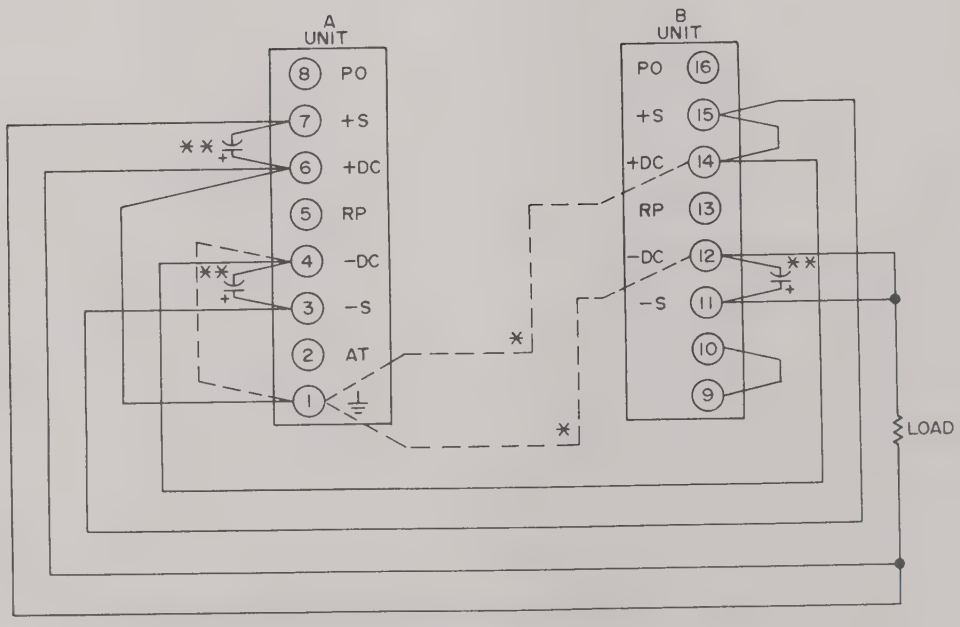
* FOR NEGATIVE GROUND DISCONNECT JUMPERS FROM TERMINALS 1-6, 1-14 AND RECONNECT TO TERMINALS 1-4, 1-12.

** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

Figure 6. Programmed Voltage, With External Programming Voltage Source



(A) LOCAL SENSING

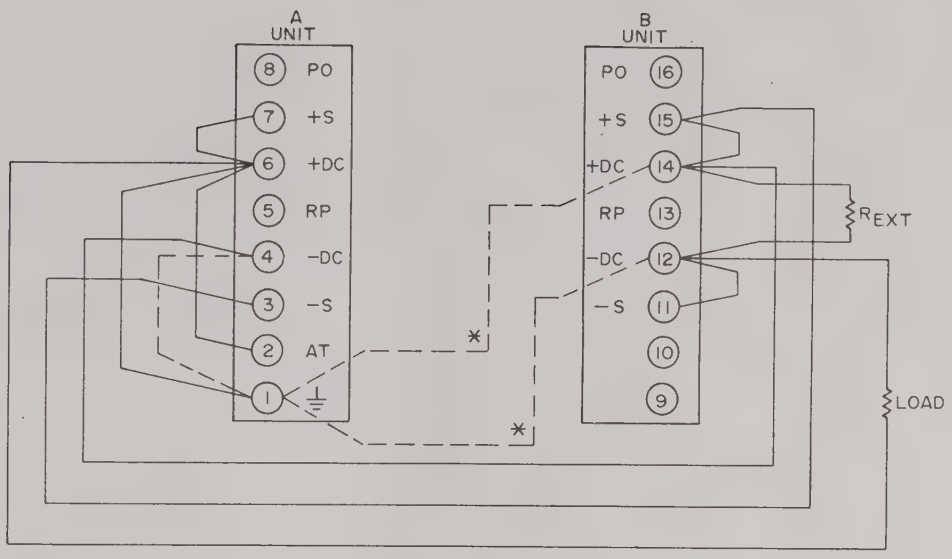


(B) REMOTE SENSING

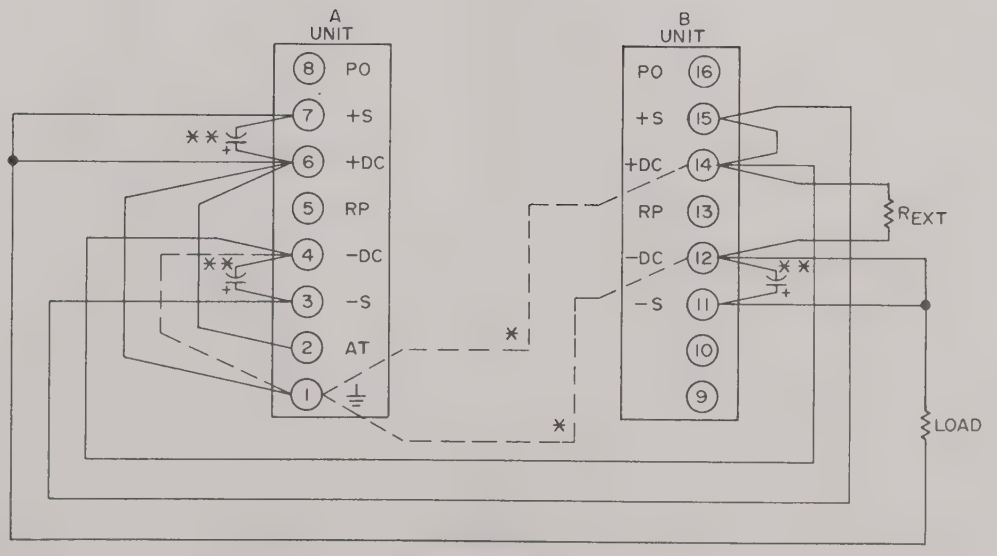
* MAKE ONLY ONE GROUND CONNECTION FOR EACH SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 1 AND 6 ON "A" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

** A 2.5MF, ELECT., CAP. MAY BE REQUIRED.

Figure 7. Series Connection



(A) LOCAL SENSING



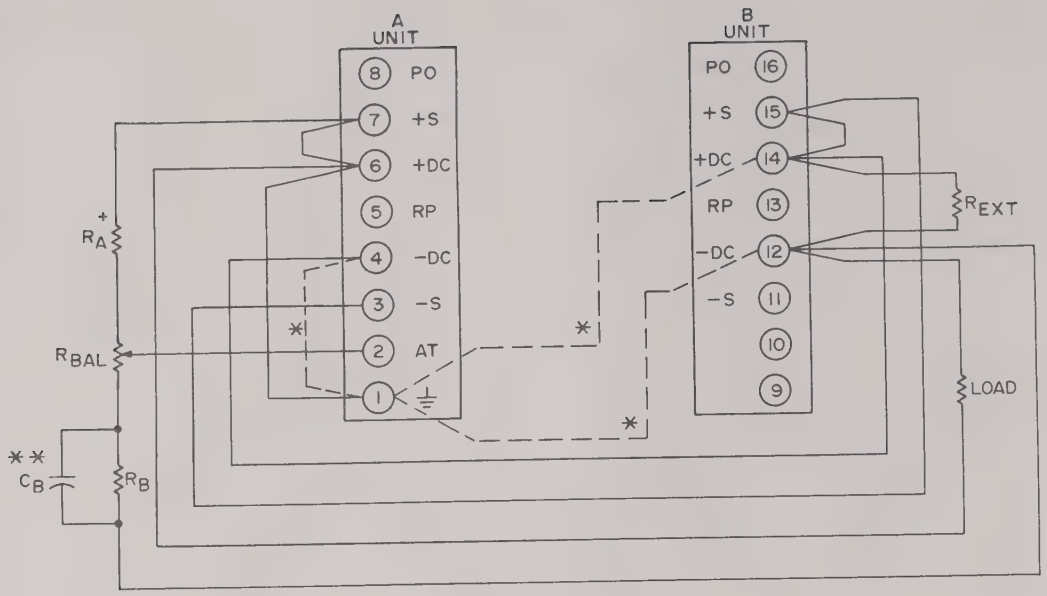
(B) REMOTE SENSING

* MAKE ONLY ONE GROUND CONNECTION FOR EACH SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 1 AND 6 ON "A" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

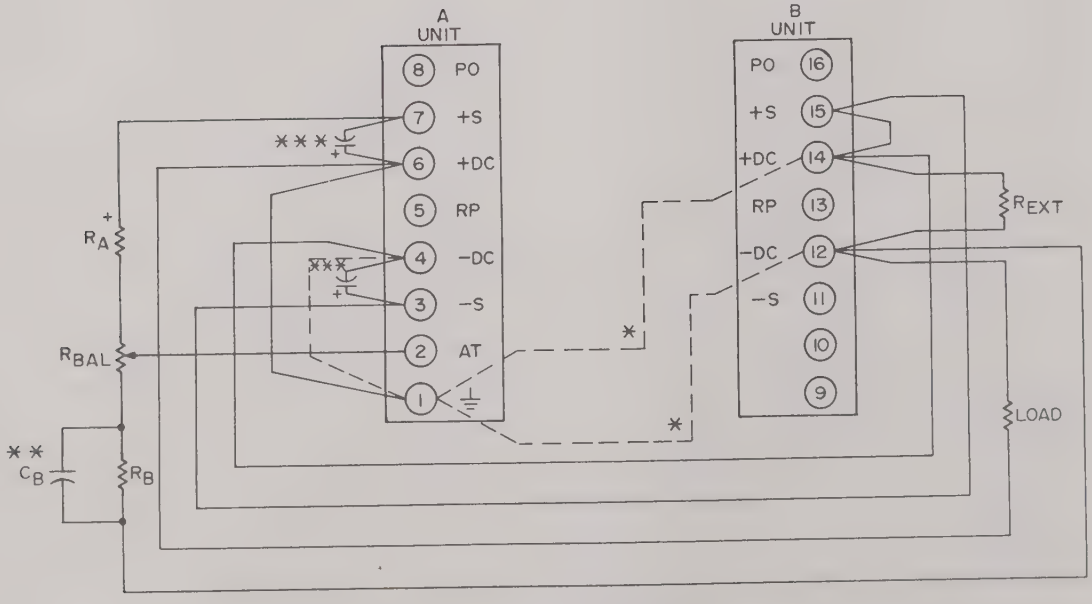
** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

NOTE: ONLY USE "A" UNIT OUTPUT VOLTAGE CONTROLS TO CONTROL OUTPUT OF THE SERIES COMBINATION; SET "B" UNIT VOLTAGE CONTROLS TO MAXIMUM.

Figure 8. Auto-Series Connection



(A) LOCAL SENSING



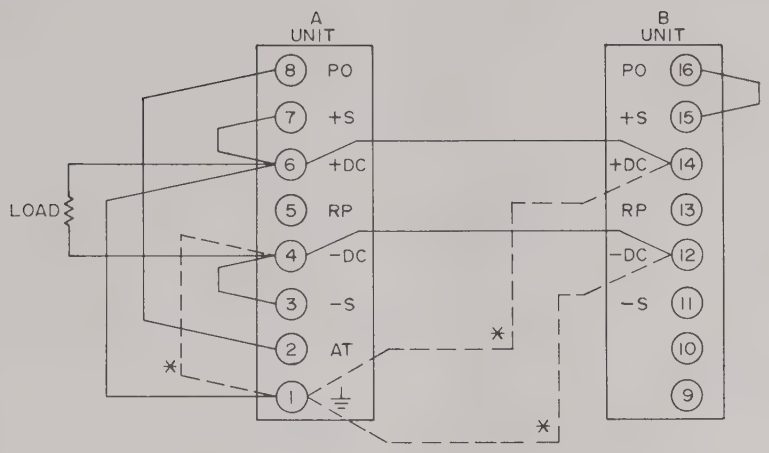
(B) REMOTE SENSING

* MAKE ONLY ONE GROUND CONNECTION FOR EACH SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 1 AND 6 ON "A" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

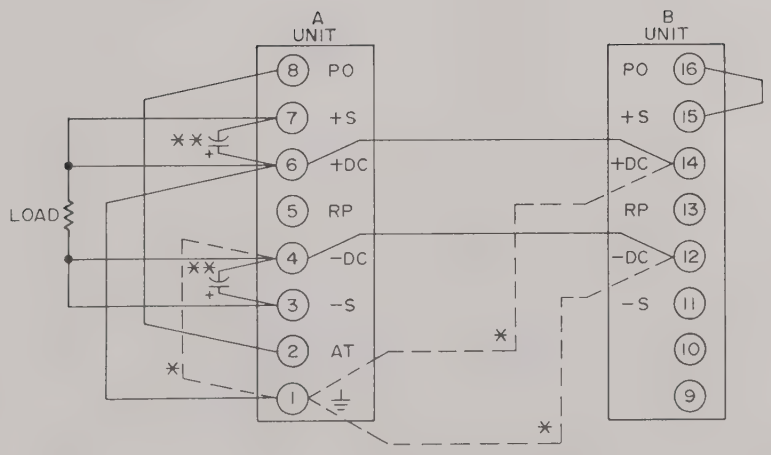
** C = 2.5MFD, 200V FOR MODELS LQD 421, 422, 423
C = 1.4MFD, 400V FOR MODELS LQD 424, 425

*** A 2.5MFD, ELECT, CAP. MAY BE REQUIRED.

Figure 9. Alternate Auto-Series Connection



(A) LOCAL SENSING

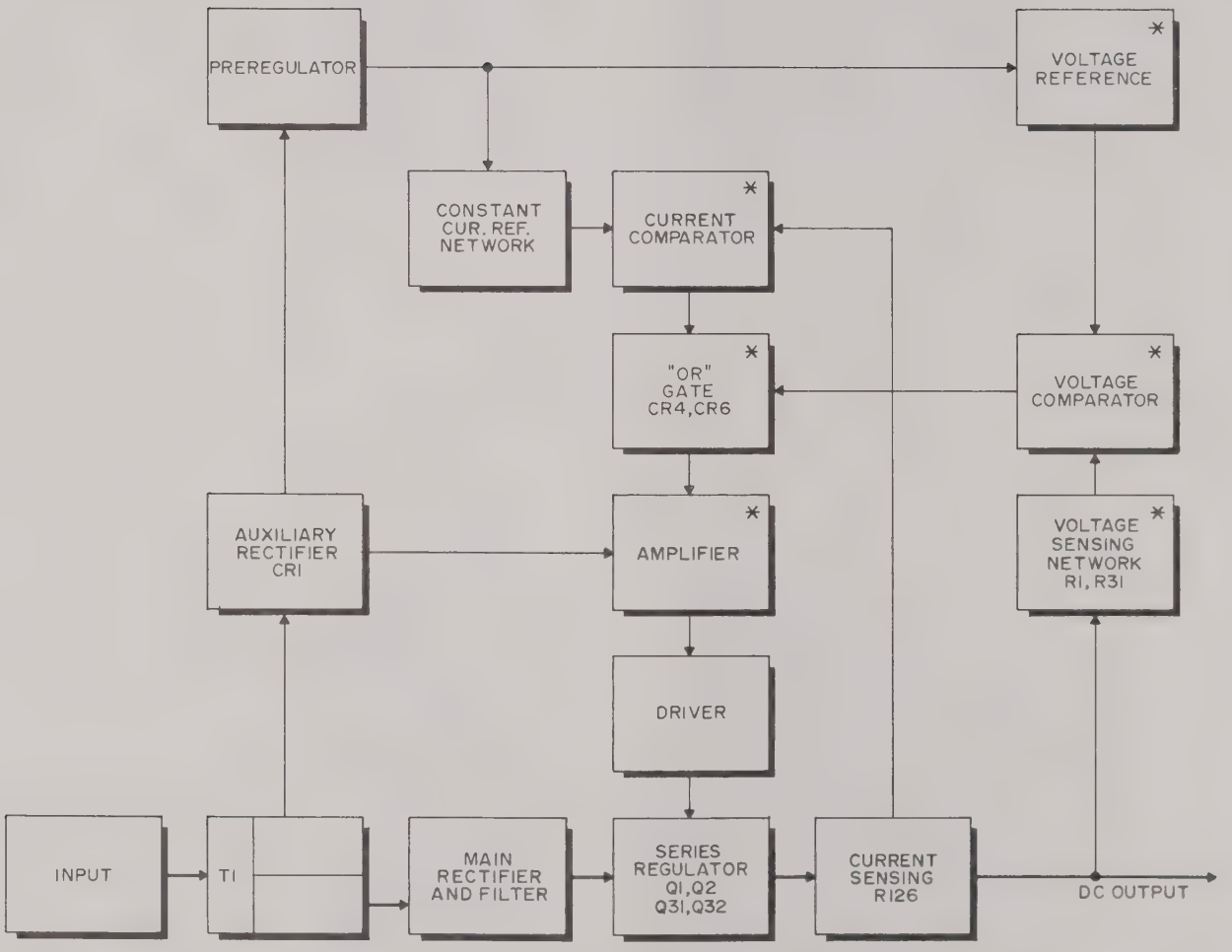


(B) REMOTE SENSING

* MAKE ONLY ONE GROUND CONNECTION FOR EACH PARALLEL COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 1 AND 6 ON "A" UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

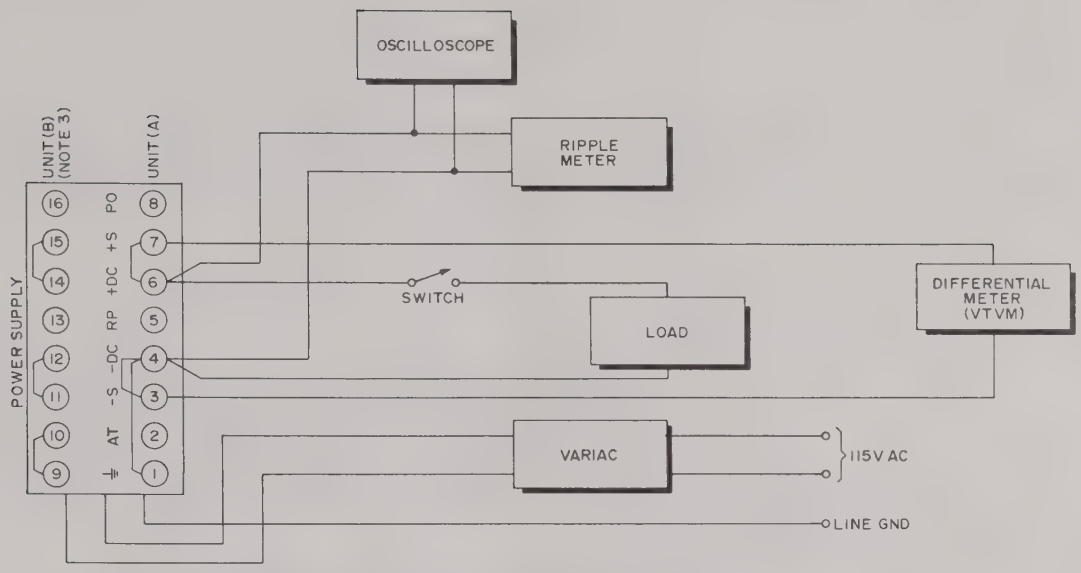
Figure 10. Parallel Connection



NOTE: THIS DIAGRAM APPLIES TO UNIT (B) EXCEPT INPUT BLOCK AND TI PRIMARY ARE NOT USED AND CIRCUIT DESIGNATION NUMBERS ARE IN THE 100 SERIES.

* THIS CIRCUIT ELEMENT IS LOCATED IN IC101

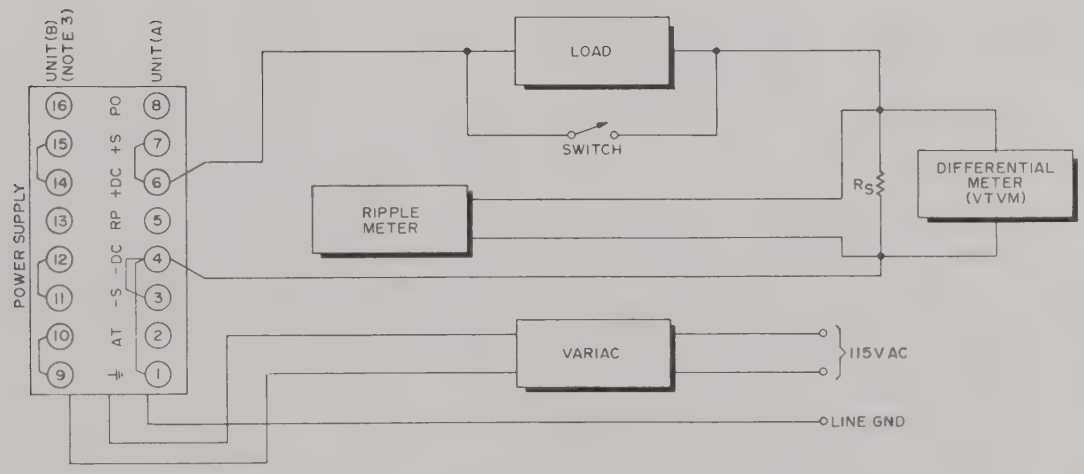
Figure 11. Typical Block Diagram



NOTES:

1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE-WIRE LINE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTIONS ONLY.
3. WHEN CHECKING UNIT (B) CONNECT TO UNIT (B) TERMINALS AND ADD JUMPERS AS SHOWN; TERMINAL 12 TO TERMINAL 1.

Figure 12. Test Connections For Constant Voltage Performance Checks



NOTES:

1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE-WIRE LINE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTIONS ONLY.
3. WHEN CHECKING UNIT (B) CONNECT TO UNIT (B) TERMINALS AND ADD JUMPERS AS SHOWN; TERMINAL 12 CONNECTS TO TERMINAL 1.

Figure 13. Test Connections For Constant Current Performance Checks

GENERAL DESCRIPTION

Rack adapter LRA-1 is designed for use in equipment racks where ruggedized mounting of units is required. The adapter can be used with or without chassis slides.

Rack adapter LRA-2 is designed for simple applications of rack installation where chassis slides and ruggedized mounting of equipment are not required.

Both rack adapter LRA-1 and LRA-2 can be used to install 1/4-rack or 1/2-rack power supply units into equipment racks. Each adapter can accept various combinations of 1/4 and 1/2-rack units up to four 1/4-rack units or two 1/2-rack units.

INSTALLATION OF 1/2 RACK UNITS INTO LRA-1

To install 1/2-rack power supply units, remove slide numbers 2 and 3 and/or 6 and 7, together with securing hardware and associated slide bar nut.

Using slide screws and slide bar nuts that were removed, store removed slides on the frame at the rear of the adapter where screw clearance holes are provided for securing each slide to the adapter.

SHIPMENT OF UNITS MOUNTED IN LRA-1

To protect the unit against damage from shock and vibrations when transporting adapter with installed units, eight universal tie-down mounting holes, located in the adapter base, at the rear of the rack adapter, are used to secure 1/4-rack and/or 1/2-rack units into the rack adapter. Secure each unit using two 6-32 x 5/8 screws, two lock-washers and two spacers installed from the bottom side of the rack adapter. See detail A for typical securing hardware. Eight spacers are supplied with rack adapter LRA-1.

RUGGEDIZED MOUNTING

When ruggedized mounting of units is required, follow the procedure described for SHIPMENT OF UNITS MOUNTED IN LRA-1. See detail A for typical securing hardware.

MOUNTING CHASSIS SLIDES

Mount chassis slides uning the following hardware. To assure unrestricted mounting of units into the adapter designated screw lengths must not be exceeded. Insert screws into designated holes and secure slide in position using long bar nut supplied with rack adapter LRA-1.

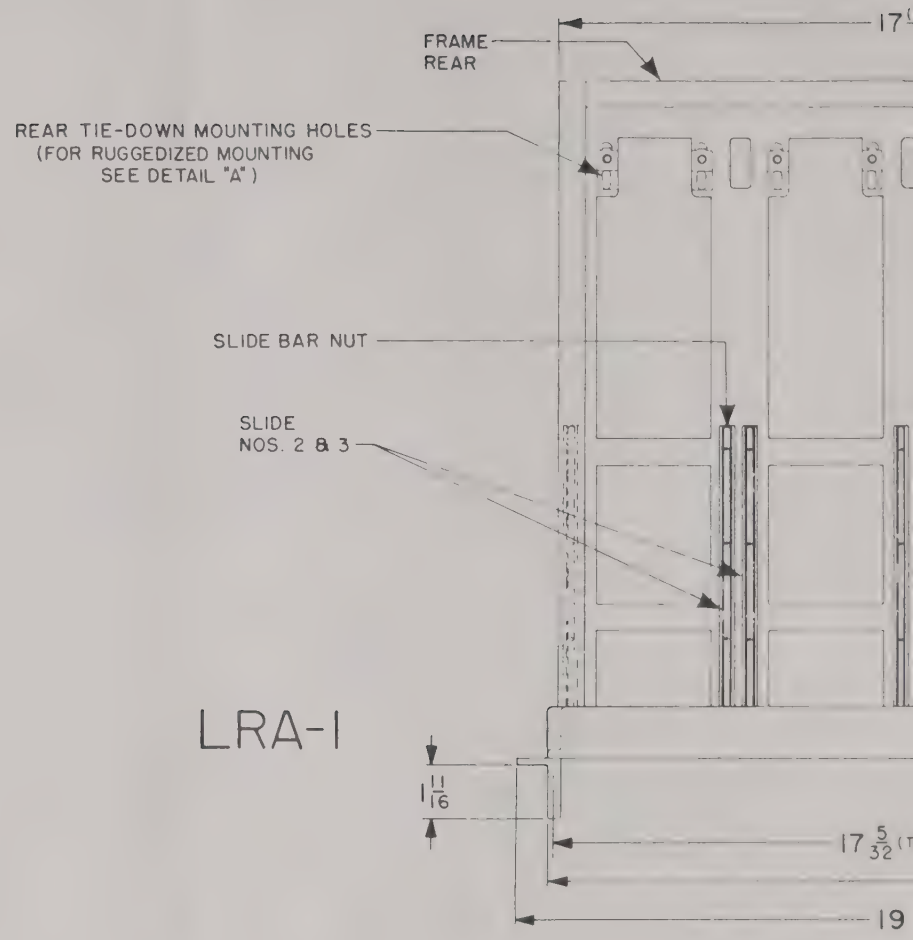
CHASSIS TRAK NO. CTS. -116:
10-32 x 7/16 fl-hd (82°);
use A holes.

LAMBDA NO. KHT-34-003 (1 PR)
6-32 x 3/8 pan-hd;
use B, C, and D holes.

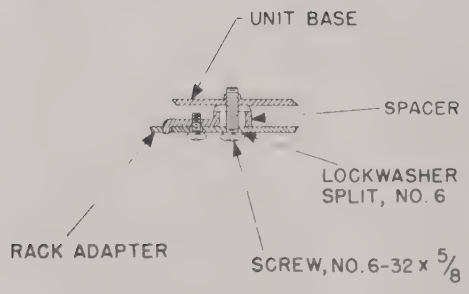
GRANT PULLEY NO. 4435:
6-32 x 5/15 fl-hd (100°);
use B and D holes.

USING BLANK PANELS

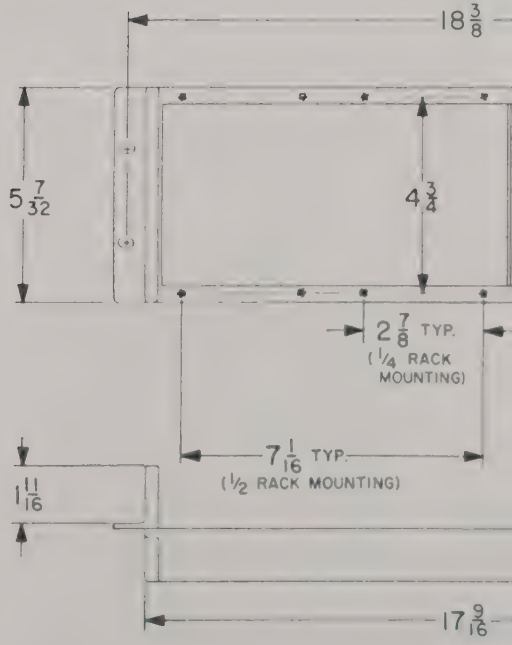
Blank front panels Model LBP-11 and LBP-21 are available for covering any 1/4-rack or 1/2-rack opening respectively. The blank panels can be used with rack adapter LRA-1 and LRA-2 whenever a 1/4-rack or 1/2-rack space in the adapter is not occupied by a unit. Secure each panel in position using four 6-32 x 3/8 pan-head screws supplied with the rack adapter.



LRA-1



DETAIL A



LRA-2

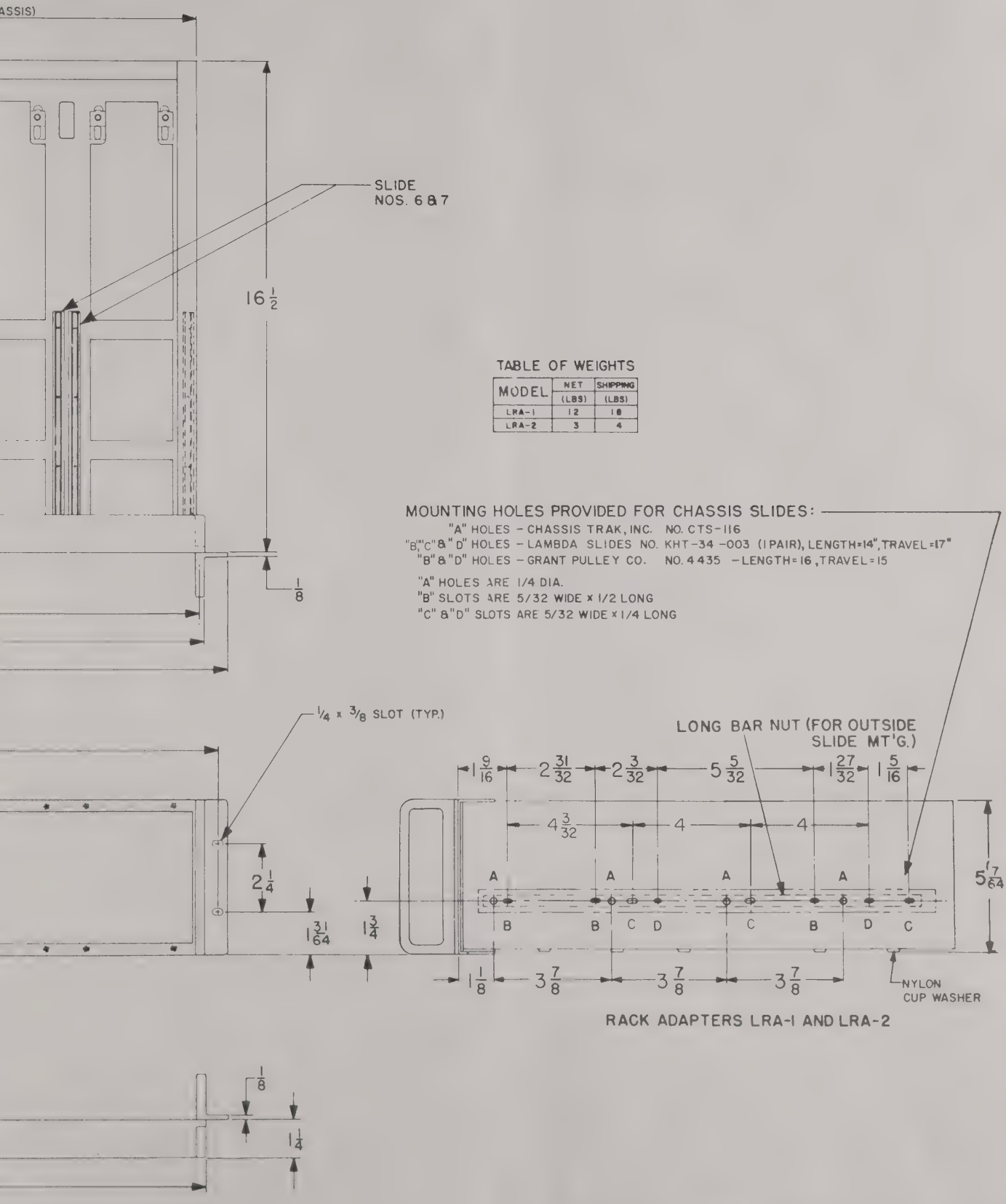
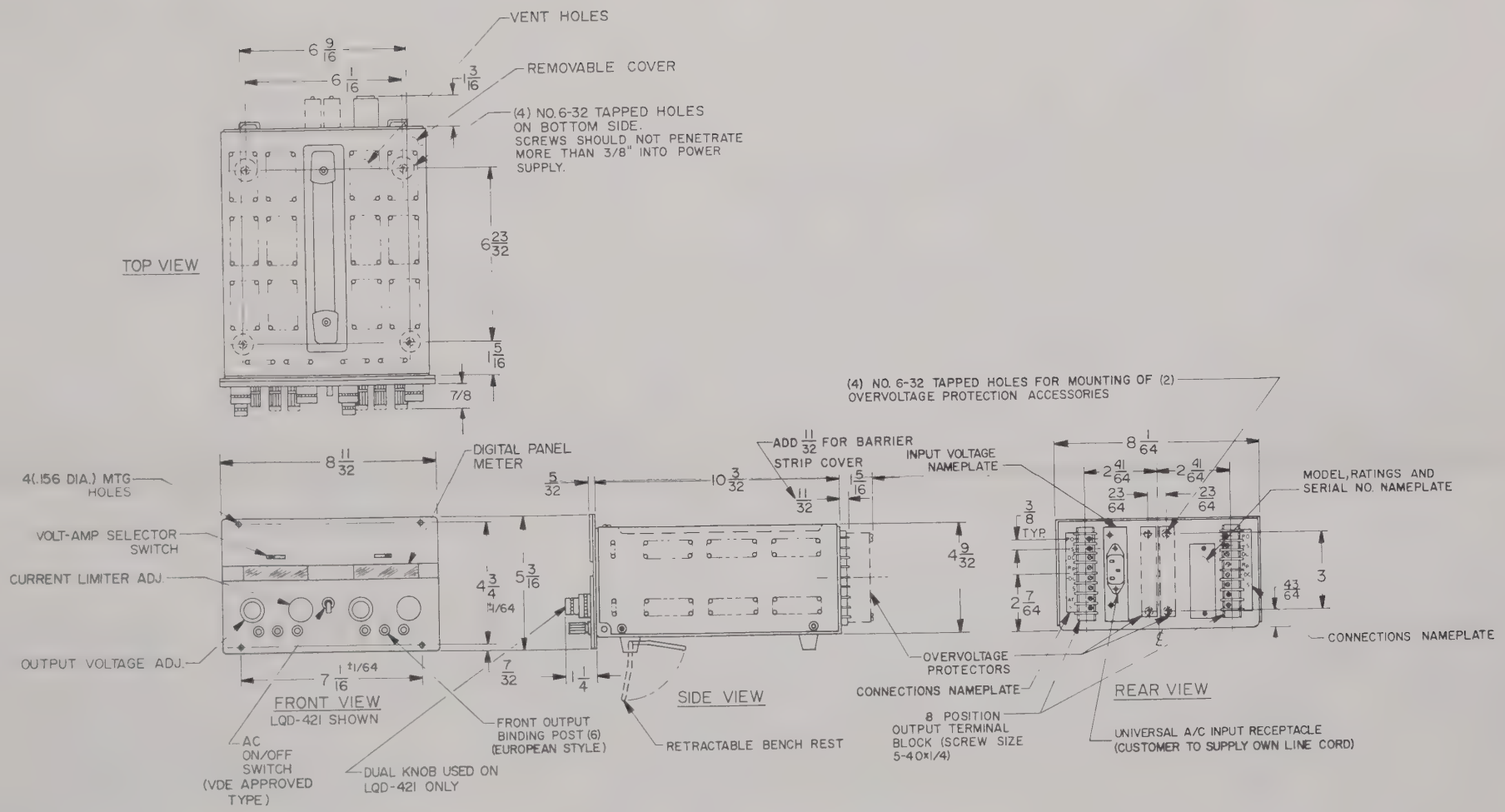


Figure 14. Rack Adapters LRA-1 and LRA-2


VENT HOLES
REMOVABLE COVER
(4) NO.6-32 TAPPED HOLES ON BOTTOM SIDE. SCREWS SHOULD NOT PENETRATE MORE THAN 3/8" INTO POWER SUPPLY.
TOP VIEW
(4) NO. 6-32 TAPPED HOLES FOR MOUNTING OF (2) OVERVOLTAGE PROTECTION ACCESSORIES
DIGITAL PANEL METER
ADD 11/32 FOR BARRIER STRIP COVER
INPUT VOLTAGE NAMEPLATE
MODEL, RATINGS AND SERIAL NO. NAMEPLATE
4(.156 DIA.) MTG HOLES
VOLT-AMP SELECTOR SWITCH
CURRENT LIMITER ADJ
OUTPUT VOLTAGE ADJ.
FRONT VIEW
LQD-421 SHOWN
SIDE VIEW
REAR VIEW
CONNECTIONS NAMEPLATE
OVERVOLTAGE PROTECTORS
AC ON/OFF SWITCH (VDE APPROVED TYPE)
DUAL KNOB USED ON LQD-421 ONLY
FRONT OUTPUT BINDING POST (6) (EUROPEAN STYLE)
RETRACTABLE BENCH REST
8 POSITION OUTPUT TERMINAL BLOCK (SCREW SIZE 5-40x1/4)
UNIVERSAL A/C INPUT RECEPTACLE (CUSTOMER TO SUPPLY OWN LINE CORD)

Outline Drawing For V and V1 Option Units

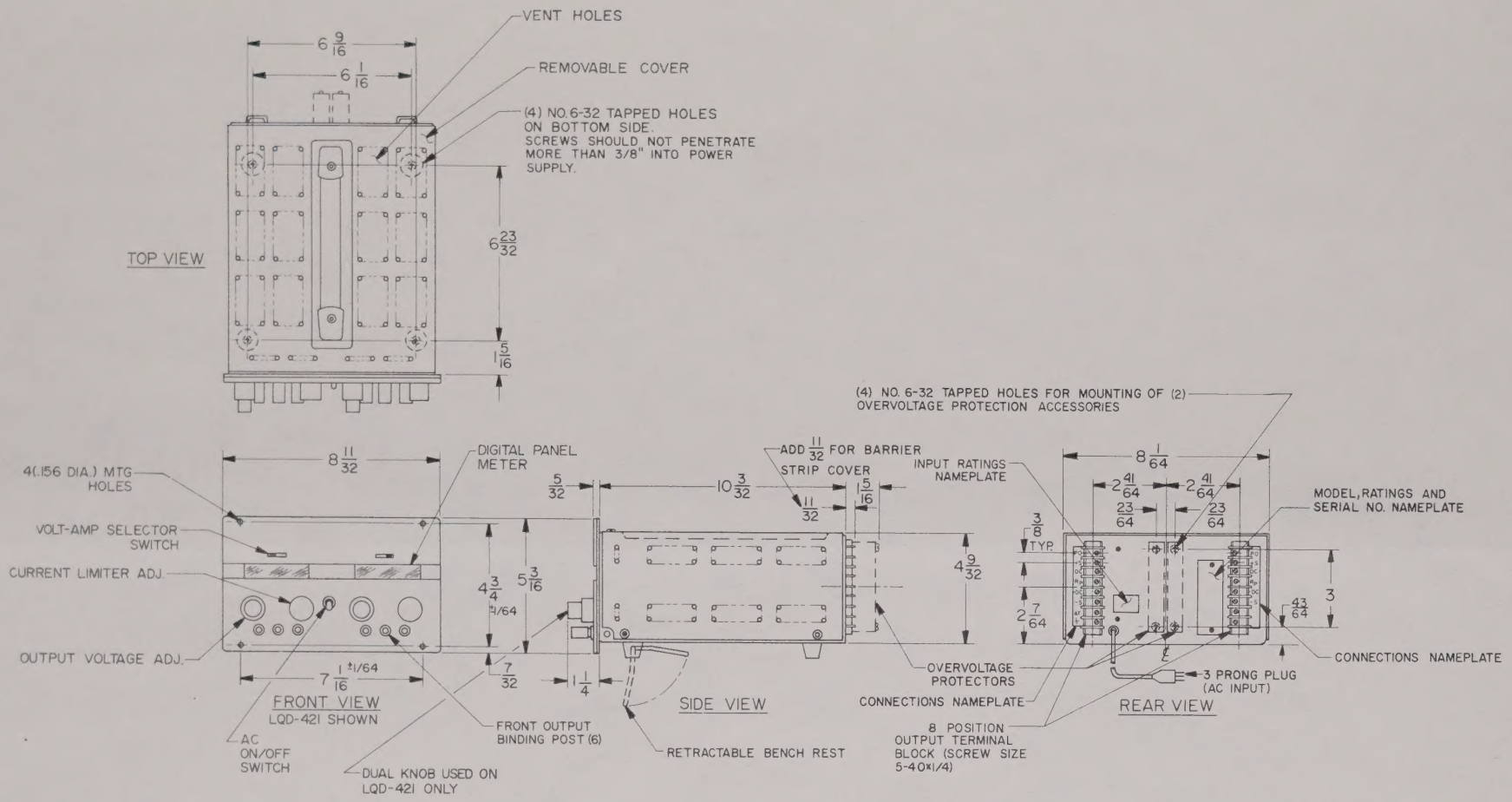

VENT HOLES
REMOVABLE COVER
(4) NO.6-32 TAPPED HOLES ON BOTTOM SIDE. SCREWS SHOULD NOT PENETRATE MORE THAN 3/8" INTO POWER SUPPLY.
TOP VIEW
(4) NO. 6-32 TAPPED HOLES FOR MOUNTING OF (2) OVERVOLTAGE PROTECTION ACCESSORIES
4(.156 DIA.) MTG HOLES
VOLT-AMP SELECTOR SWITCH
CURRENT LIMITER ADJ.
OUTPUT VOLTAGE ADJ.
DIGITAL PANEL METER
ADD 11/32 FOR BARRIER STRIP COVER
INPUT RATINGS NAMEPLATE
MODEL, RATINGS AND SERIAL NO. NAMEPLATE
FRONT VIEW
LQD-421 SHOWN
AC ON/OFF SWITCH
DUAL KNOB USED ON LQD-421 ONLY
FRONT OUTPUT BINDING POST (6)
SIDE VIEW
RETRACTABLE BENCH REST
OVERVOLTAGE PROTECTORS
CONNECTIONS NAMEPLATE
8 POSITION OUTPUT TERMINAL BLOCK (SCREW SIZE 5-40x1/4)
REAR VIEW
3 PRONG PLUG (AC INPUT)
CONNECTIONS NAMEPLATE

Figure 15. Outline Drawing

5-Year Guarantee

We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.

We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

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